DECLARATION

I, Im Yeon SEOL, a Korean citizen of A-205, Golden Hill, Anam-5-ga, Seoungbuk-gu, Seoul, Korea do hereby solemnly and sincerely declare as follows:

1. That I am well acquainted with the English and Korean languages.
2. That the following is a correct translation into English of the accompanying certified copy of a Korean Patent Application No. 2001-5289, and I make the solemn declaration conscientiously believing the same to be true.

Seoul, November 23, 2004

Im Yeon SEOL

KOREAN INTELLECTUAL PROPERTY OFFICE

This is to certify that the following application annexed hereto is a true copy from the records of the Korean Intellectual Property Office.

Application Number: Patent Application No. 2001-5289

Date of Application: February 3, 2001

Applicant(s): Samsung Electronics Co., Ltd.

Dated on March 20, 2001

COMMISSIONER

[DOCUMENT] Application for Patent

[RIGHT] Patent

[TO] The commissioner

[REFERENCE NO] 0006

[SUBMISSION DATE] February 3, 2001

[TITLE OF THE INVENTION-KOREAN] 무선 통신기기 및 그 통신방법 및 이를 적용한 무선 통신시스템

[TITLE OF THE INVENTION-ENGLISH] Wireless communication apparatus, the method thereof and wireless communication system employing the same

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[PURPOSE] I, hereby, submit the present application for the Patent under the Article 42 of the Patent Law.

Attorney Hong-sik JEONG (seal)

[Official Fee]

[Basic fee]	20	pages	₩	29,000
[Additional fee]	6	pages	₩	6,000
[Claiming Priority Right]	0	case	₩	0
[Filing Request For Examination]	0	claim	₩	0

[Total]		₩	0
[Documents]	1. One copy of Abstract, Specification (& drawings)		
	2. One copy of Power of Attorney		

[ABSTRACT OF THE DISCLOSURE]

[Abstract]

A wireless communication apparatus, a method thereof, and a wireless communication system employing the same. The wireless communication apparatus for transmitting and receiving data wirelessly includes a transmitting portion for transmitting the data through at least one frequency channel, and a controller for obtaining a number of transmittable channels of a counterpart wireless communication apparatus intended to communicate with, and processing to transmit the data through the transmitting portion according to the obtained number of transmittable channels. Accordingly, data can be transmitted and received simultaneously through multiple channels, and time consumption for the data transmission and reception can be greatly reduced.

[The main figure]

FIG. 8

[Search term]

Bluetooth, frequency channel

[SPECIFICATION]

[The title of the invention]

Wireless communication apparatus, the method thereof and wireless communication system employing the same

[The brief description of the drawings]

FIG. 1 is a view showing the structure of a piconet of a general Bluetooth communication system,

FIG. 2A is a view showing frequency channels of the general Bluetooth communication system,

FIG. 2B is a view showing a frequency hopping among the frequency channels of FIG. 2A,

FIG. 3 is a block diagram showing a wireless communication apparatus in accordance with a preferred embodiment of the present invention,

FIG. 4 is a view showing a transceiving portion of the wireless communication apparatus of FIG. 3,

FIGS. 5a and 5b are views showing examples of opening four frequency channels of the wireless communication apparatus, respectively,

FIG. 6 is a flow chart showing the process of the wireless communication apparatus of FIG. 3, communicating in accordance with a first preferred embodiment of the present invention,

FIG. 7A is a view showing allocation of non-real time data to the channels, and FIG. 7B is a view swing real-time data to the channels, respectively,

FIG. 8 is a flow chart showing the process of wireless communication apparatus of FIG. 3, communicating in accordance with a second preferred embodiment of the present

invention.

Description of the reference numerals in the drawings

20, 30: wireless communication apparatus 21: transceiving portion

23, 33: controller 40: host

M: master device

S1, S2, S3, S4, S5, S6, S7: slave device

[Detailed description of the invention]

[Object of the invention]

[The field of the invention and the related art]

The present invention relates to a wireless communication apparatus and communication method thereof, and more particularly to a wireless communication apparatus, a method thereof and a wireless communication system capable of transmitting and receiving data via a plurality of channels in a Bluetooth system.

A Bluetooth communication has become popular recently, for its advantage that enables transmission of data such as audio data, video data, etc at a speed of maximum 1Mbps within a distance ranging from 10m to 100m.

The general Bluetooth system uses an Industrial Scientific Medical bandwidth of 2.4GHz.

FIG. 1 shows the structure of a piconet in the general Bluetooth communication system.

Referring to FIG. 1, the Bluetooth communication system includes one master device M and a plurality of slave devices S_1-S_7 connected with each other. As described, the network in which one master device M is connected with at least one slave device S_1-S_7, is called a 'piconet'. In one piconet, maximum seven (7) slave devices can be connected for one master

M in an active state.

FIG. 2A shows a frequency channel of the general Bluetooth communication system.

A pair of devices, i.e., one master device and one slave device communicates with each other through one of seventy-nine (79) channels of 1MHz bandwidth in the frequency band of 2.4GHz for a time corresponding to a certain number of time slots (625μs-3.125ms). Data transmission rate per channel is 1Mbps.

Further, in order to prevent interference among channels and fading effect during communication, a Frequency Hopping method is employed.

FIG. 2B shows the frequency hopping among the frequency channels of FIG. 2A.

The data is exchanged in packets through the channels, and the respective packets are transmitted in another hoping frequency. One packet is comprised of one, three, or five time slots.

In the current Bluetooth system, however, since the master device and the slave devices communicate in series only through one channel, there is a limit on the transmission speed.

Accordingly, even when there is much data to send, the data has to be transmitted at a limited speed.

[Technical object of the invention]

The present invention has been made to overcome the above-mentioned problems of the related art, and accordingly, it is an object of the present invention to provide a wireless communication apparatus, a method thereof, and a wireless communication system capable of transmitting and receiving substantial amount of data in parallel.

[Construction and operation of the invention]

The above object is accomplished by a wireless communication apparatus for

transmitting and receiving data wirelessly in accordance with the present invention, including a transmitting portion for transmitting the data through at least one frequency channel; and a controller for obtaining a number of transmittable channels of a counterpart wireless communication apparatus intended to communicate with, and processing to transmit the data through the transmitting portion according to the obtained number of transmittable channels.

When another wireless communication apparatus receives the data through a plurality of frequency channels, the controller transmits the data through the plurality of frequency channels to the counterpart wireless communication apparatus.

When the wireless communication apparatus is operated as a master, the controller obtains the number of transmittable channels of the counterpart wireless communication apparatus, by performing an inquiry operation on the counterpart wireless communication apparatus.

Further, it is preferable that the frequency channel includes a basic channel for supporting a communication with other wireless communication apparatuses having a single channel, and a plurality of additional channels consecutively or inconsecutively positioned with respect to the basic channel.

The above object is also accomplished by a wireless communication apparatus for transmitting and receiving data wirelessly in accordance with the present invention, including a transmitting portion for transmitting the data through a plurality of frequency channels; and a controller for dividing the data for transmission by a number of frequency channels, and processing to transmit the data to a counterpart wireless communication apparatus that is intended to communicate with.

The above object is also accomplished by a method of a wireless communication apparatus for transmitting and receiving data wirelessly in accordance with the present

invention, including the steps of (a) a source wireless communication apparatus obtaining a number of transmittable frequency channels of a counterpart wireless communication apparatus intended to communicate with, and (b) transmitting the data according to the number of transmittable frequency channels of the counterpart wireless communication apparatus.

The method of a wireless communication apparatus for transmitting and receiving data wirelessly in accordance with the present invention, further includes the step of dividing the data for transmission by a number of a plurality of frequency channels, and transmitting the data to a counterpart wireless communication apparatus that is intended to communicate with.

The above object is also accomplished by a wireless communication system in accordance with the present invention, including a plurality of wireless communication apparatuses operated as a master or a slave, wherein a wireless communication apparatus operated as the master obtains a number of transmittable frequency channels of a wireless communication apparatus operated as the slave, and transmits data according to the obtained number of transmittable frequency channels of the wireless communication apparatus operated as the slave.

Further, the above object is also accomplished by a wireless communication system in accordance with the present invention, including a plurality of wireless communication apparatuses operated as a master or a slave, wherein the wireless communication apparatus operated as the master divides data for transmission by a number of a plurality of frequency channels, and transmits the data to a wireless communication apparatus operated as the slave.

The preferred embodiments of the present invention will now be described with reference to the accompanying drawings, while the like elements are given the same

reference numerals throughout and any redundant explanation is omitted as possible.

FIG. 3 is a block diagram showing the wireless communication apparatus in accordance with the preferred embodiments of the present invention.

As shown in FIG. 3, a wireless communication apparatus 20(30) includes a transceiving portion (21), and a controller 23(33). The reference numerals 20, 23, and 40 refer to the wireless communication apparatus and elements thereof that are operated in accordance with the first preferred embodiment of the present invention, while the reference numerals in parenthesis, i.e., 30, 33, and 50 refer to the wireless communication apparatus and elements thereof that are operated in accordance with the second preferred embodiment of the present invention.

The transceiving portion 21 of the Bluetooth communication system processes radio frequency of 2.4GHz, and sends out a packet for transmission.

FIG. 4 is a view showing the transceiving portion of the wireless communication apparatus of FIG. 3.

The transceiving portion 21 includes a plurality of data modulator/demodulators d1-dn, and thus is capable of opening a plurality of channels and transmitting/receiving in parallel the data through the open channels.

FIGS. 5a and 5b show examples of opening four frequency channels of the wireless communication apparatus, respectively.

Here, one open frequency channel includes one (1) basic channel CH1, with three (3) additional channels CH2, CH3, and CH4.

The basic channel CH1 is identical to the channel used by other wireless communication apparatuses, and set to support the communication with other wireless communication apparatuses.

According to the conditions such as efficient configuration, Bit Error Ratio (BER), or the like, the additional channels CH2, CH3, CH4 may either be consecutively or inconsecutively established with reference to the basic channel CH1 (see FIGS. 5(a) and 5(b)).

The controller 23(33) is connected to the host 40(50) via a Host Controller Interface (HCI, not shown), and transmits and receives data and control signal. Here, the host 40(50) may include various communication terminals such as laptop computers, mobile phones, printer, etc.

The controller 23(33) performs functions of transceiving portion control, link control, packet control, logic channel control, data whitening, allocation of address, and security.

Further, the controller 23(33) transmits and receives data in parallel with the transceiving portion 21(31) and host 40(50) through a plurality of channels. When the controller 23(33) transmits data in parallel, the controller 23(33) applies a frequency hopping pattern to the additional channels CH2, CH3, CH4, corresponding to the frequency hopping pattern applied to the basic channel CH1.

According to the first preferred embodiment of the present invention, in the wireless communication apparatus that intends to transmit data (hereinafter briefly called 'transmitting apparatus'), the controller 23 obtains frequency channel characteristics of another wireless communication apparatus that is an intended recipient of the data transmission (hereinafter briefly called 'receiving apparatus'), and processes to transmit the data through the transceiving portion 21 according to the frequency channel characteristics of the receiving apparatus.

The data transmission/reception method of the transmitting apparatus 20 with another wireless communication apparatus connected thereto in accordance with the first preferred embodiment will be described below with reference to FIG. 6.

Referring to FIG. 6, the transmitting apparatus 20 obtains the frequency channel characteristics of the receiving apparatus (step S102).

More specifically, the transmitting apparatus 20 checks whether the receiving apparatus transmits data through a single channel as in the current Bluetooth communication system, or through multiple channels as in the first preferred embodiment of the present invention.

At this time, if the transmitting apparatus 20 is a master in the piconet, the transmitting apparatus 20 performs an inquiry operation with the receiving apparatus, or obtains the frequency channel characteristics of the receiving apparatus based on the Link Message Protocol (LMP) of the receiving apparatus.

Based on such obtained frequency channel characteristics of the receiving apparatus, the transmitting apparatus determines whether the receiving apparatus can receive the data through the multiple frequency channels (step S104).

If the receiving apparatus can receive the data through the multiple frequency channels, the transmitting apparatus divides the data by a number of the frequency channels (step S106), and transmits the data through the multiple frequency channels (step S108).

If the receiving apparatus can receive the data only through one frequency channel, then the transmitting apparatus transmits the data through the one frequency channel (step S110).

According to second preferred embodiment of the present invention, irrespective of the data reception capacity of the receiving apparatus, the controller 33 divides the data by the number of the frequency channels and processes to transmit the data to the receiving apparatus.

At this time, the controller 33 divides the data, respectively, depending on whether the

data is for real time transmission or non-real time transmission.

FIGS. 7A and 7B show examples of real time and non-real time data divisions, respectively.

If the data is for non-real time transmission, the controller 33 divides the real time data by the number of open channels into respective levels as shown in FIG. 7A.

If the data is for real time transmission, the controller 33 divides the real time data by the number of transmittable channels into respective levels as shown in FIG. 7B. Then the controller 33 sets the basic information essential for utilization of real time data as the first level information, and allocates the first level information to the basic bandwidth. The controller 33 allocates information of lower levels to the additional bandwidth.

Further, the controller 33 checks the data reception through the respective frequency channels of the receiving apparatus, and obtains the frequency channel characteristics of the receiving apparatus. The controller then processes to transmit the data according to the frequency channel characteristics of the receiving apparatus.

Next, data transmission/reception method of the wireless communication apparatus 30 with another wireless communication apparatus connected thereto in accordance with the second preferred embodiment of the present invention will be described below with reference to FIG. 8.

Referring to FIG. 8, the wireless communication apparatus 30, which intends to transmits data, (hereinafter briefly called 'transmitting apparatus'), divides the data for transmission by the number of transmittable channels (step S201). Then the transmitting apparatus transmits the data through the multiple frequency channels (step S202).

Next, the transmitting apparatus receives from the receiving wireless communication apparatus response signals for the respective frequency channels (step S204).

According to the received response signals for the respective frequency channels, the transmitting apparatus 30 determines whether the receiving apparatus can receive the data through the multiple frequency channels (step S204).

If the receiving apparatus is determined to be able to receive the data through the multiple frequency channels, the transmitting apparatus 30 transmits the data, which is divided by the number of frequency channels, through the multiple frequency channels, respectively (step S208).

If the receiving apparatus is determined to be able to receive the data only through one frequency channel, the transmitting apparatus 30 checks whether the data is real time data or non-real time data (step S210).

Here, the real time data means the data that has to be consecutively transmitted, such as video data, audio data, or the like.

If the data is non-real time data, the transmitting apparatus 30 transmits the divided data all through the basic channel (step S212).

Meanwhile, if the data is non-real time data, the transmitting apparatus 30 transmits the data allocated to the basic channel through the basic channel (step S214). Accordingly, the data of the highest level is transmitted through the basic bandwidth.

The present invention should not be limited to the preferred embodiments described above but various changes and modifications can be made by one skilled in the art without departing from the spirit and scope of the present invention.

For example, although the Bluetooth system is described as an example in the above preferred embodiments, the present invention is also applicable to a general wireless communication system which communicates through a single channel. Accordingly, it would be understood that the present invention should not be limited to the preferred

embodiments but limited to the scope of the present invention as hereinafter claimed.

[Effect of the invention]

As described above, according to the wireless communication apparatus, method thereof, and wireless communication system employing the same, since the data is transmitted and received simultaneously by using multiple channels, and still with compatibility with existing wireless communication apparatus using a single channel, a substantial amount of data can be transmitted and received simultaneously.

Further, according to the present invention, due to increased number of data transmitting channels, the time consumption for data transmission is reduced.

[What is claimed is]

[Claim 1]

A wireless communication apparatus transmitting and receiving data wirelessly, comprising:

a transmitting portion for transmitting the data through at least one frequency channel; and

a controller for obtaining a number of transmittable channels of a counterpart wireless communication apparatus intended to communicate with, and processing to transmit the data through the transmitting portion according to the obtained number of transmittable channels.

[Claim 2]

The wireless communication apparatus of claim 1, wherein, when the counterpart wireless communication apparatus receives the data through a plurality of frequency channels, the controller transmits the data through the plurality of frequency channels to the counterpart wireless communication apparatus.

[Claim 3]

The wireless communication apparatus of claim 1, wherein, when the wireless communication apparatus is operated as a master, the controller obtains the number of transmittable channels of the counterpart wireless communication apparatus, by performing an inquiry operation with the counterpart wireless communication apparatus.

[Claim 4]

The wireless communication apparatus of claim 1, wherein the at least one frequency channel includes a basic channel for supporting a communication with other wireless communication apparatuses having a single channel, and a plurality of additional channels consecutively or inconsecutively positioned with respect to the basic channel.

[Claim 5]

The wireless communication apparatus of claim 4, wherein, while transmitting the data in parallel, the controller applies a frequency hopping pattern to the plurality of additional channels, corresponding to a frequency hopping pattern applied to the basic channel.

[Claim 6]

A wireless communication apparatus for transmitting and receiving data wirelessly, comprising:

a transmitting portion for transmitting the data through a plurality of frequency channels; and

a controller for dividing the data for transmission by a number of frequency channels, and processing to transmit the data to a counterpart wireless communication apparatus intended to communicate with.

[Claim 7]

The wireless communication apparatus of claim 6, wherein the plurality of frequency channels include a basic channel for supporting a communication with other wireless communication apparatuses having a single channel, and a plurality of additional channels consecutively or inconsecutively positioned with respect to the basic channel.

[Claim 8]

The wireless communication apparatus of claim 7, wherein, while transmitting the data in parallel, the controller applies a frequency hopping pattern to the plurality of additional channels, corresponding to a frequency hopping pattern applied to the basic channel.

[Claim 9]

The wireless communication apparatus of claim 6, wherein, when the data for transmission is real time data, the controller grades the real time data, and transmits essential data of a basic grade for utilization of the data through the basic channel, and transmits the data of other grades through the plurality of additional channels.

[Claim 10]

The wireless communication apparatus of claim 6, wherein the controller obtains a number of transmittable channels of a counterpart wireless communication apparatus intended to communicate with by checking whether the counterpart wireless communication apparatus receives data in the respective channels, and processes to transmit the data through the transmitting portion according to the obtained number of transmittable channels of the counterpart wireless communication apparatus.

[Claim 11]

The wireless communication apparatus of claim 10, wherein, when the counterpart wireless communication apparatus receives the data through one channel, the controller

transmits the data through the basic channel.

[Claim 12]

A method of a wireless communication apparatus for transmitting and receiving data wirelessly, comprising the steps of:

a) A source wireless communication apparatus obtaining a number of transmittable frequency channels of a counterpart wireless communication apparatus; and

b) transmitting the data according to the number of transmittable frequency channels of the counterpart wireless communication apparatus.

[Claim 13]

The method of claim 12, wherein, when the counterpart wireless communication apparatus receives the data through a plurality of frequency channels, the step b) processes to transmit the data through the plurality of frequency channels.

[Claim 14]

The method of claim 12, wherein, when the wireless communication apparatus is operated as a master, the wireless communication apparatus obtains the number of transmittable frequency channels of the counterpart wireless communication apparatus by performing an inquiry operation on the counterpart wireless communication apparatus.

[Claim 15]

The method of claim 12, wherein the frequency channels comprise a basic channel for supporting a communication with other wireless communication apparatuses having a single channel, and a plurality of additional channels consecutively or inconsecutively positioned with respect to the basic channel.

[Claim 16]

The method of claim 15, wherein, when the data is transmitted in parallel, a

frequency hopping pattern is applied to the plurality of additional channels, corresponding to a frequency hopping pattern applied to the basic channel.

[Claim 17]

A method of a wireless communication apparatus for transmitting and receiving data wirelessly, comprising the step of dividing the data for transmission by a number of a plurality of frequency channels, and transmitting the data to a counterpart wireless communication apparatus intended to communicate with.

[Claim 18]

The method of claim 17, wherein the plurality of frequency channels comprise a basic channel for supporting a communication with other wireless communication apparatuses having a single channel, and a plurality of additional channels consecutively or inconsecutively positioned with respect to the basic channel.

[Claim 19]

The method of claim 17, wherein, when the data is transmitted in parallel, a frequency hopping pattern is applied to the plurality of additional channels, corresponding to a frequency hopping pattern applied to the basic channel.

[Claim 20]

The method of claim 17, wherein, when the data for transmission is real time data, the data is graded into respective grades, and essential data of a basic grade for utilization of the data is transmitted through the basic channel, and the data of other grades is transmitted through the plurality of additional channels.

[Claim 21]

The method of claim 17, further comprising the steps of:

obtaining a number of transmittable frequency channels of a counterpart wireless

communication apparatus intended to communicate with, by checking whether the counterpart wireless communication apparatus receives the data in the respective channels; and

processing to transmit the data according to the transmittable frequency channels to the counterpart wireless communication apparatus.

[Claim 22]

The method of claim 21, wherein, when the counterpart wireless communication apparatus receives the data only through one frequency channel, the data is transmitted through a basic channel.

[Claim 23]

A wireless communication system comprising a plurality of wireless communication apparatuses operated as a master or a slave, wherein a wireless communication apparatus operated as the master obtains a number of transmittable frequency channels of a wireless communication apparatus operated as the slave, and transmits data according to the obtained number of transmittable frequency channels of the wireless communication apparatus operated as the slave.

[Claim 24]

A wireless communication system comprising a plurality of wireless communication apparatuses operated as a master or a slave, wherein the wireless communication apparatus operated as the master divides data for transmission by a number of a plurality of frequency channels, and transmits the data to a wireless communication apparatus operated as the slave.

FIG. 1

PICONET

FIG. 2A

FREQUENCY

79 CHANNELS

FIG. 2B

FREQUENCY

FREQUENCY HOPPING

SLOT 1

FREQUENCY

FREQUENCY HOPPING

SLOT 2

FREQUENCY

CHANNEL 0

CHANNEL 1

CHANNEL 2

CHANNEL 3

CHANNEL 4

CHANNEL 5

CHANNEL 6

CHANNEL 7

CHANNEL 8

CHANNEL 9

CHANNEL 10

CHANNEL 11

CHANNEL 12

CHANNEL 13

CHANNEL 14

FIG. 3

EXTERNAL APPARATUSES

21 TRANSCEIVING PORTION

23 CONTROLLER

40 HOST

FIG. 4

1ST (DE)MODULATOR

2ND (DE)MODULATOR

3RD (DE)MODULATOR

(N)TH (DE)MODULATOR

FIG. 5

(A), (B)

FREQUENCY

CHANNEL 0

CHANNEL 1

CHANNEL 2

CHANNEL 3

CHANNEL 4

CHANNEL 5

CHANNEL 6

CHANNEL 7

CHANNEL 8

CHANNEL 9

CHANNEL 10

CHANNEL 11

CHANNEL 12

CHANNEL 13

CHANNEL 14

FIG. 6

START

102 CHECK NUMBER OF CHANNELS TO RECEIVING WIRELESS COMMUNICATION APPARATUS

104 IS TRANSMISSION THRU MULTIPLE CHANNELS POSSIBLE?

106 DIVIDE DATA BY NUMBER OF CHANNELS

108 TRANSMIT DATA THRU MULTIPLE CHANNELS

110 TRANSMIT DATA THRU ONE CHANNEL

END

FIG. 7A

DATA FOR NON-REAL TIME TRANSMISSION

CHANNEL 1

CHANNEL 2

CHANNEL 3

CHANNEL 4

FIG. 7B

DATA FOR REAL TIME TRANSMISSION

IMAGE

LEVEL 1 CHANNEL 1

LEVEL 2 CHANNEL 2

LEVEL 3 CHANNEL 3

LEVEL 4 CHANNEL 4

FIG. 8

START

201 DIVIDE DATA FOR TRANSMISSION BY NUMBER OF CHANNELS

202 TRANSMIT DATA THRU MULTIPLE CHANNELS

204 RECEIVE RESPONSE SIGNAL FOR CHANNELS FROM RECEIVING WIRELESS COMMUNICATION APPARATUS

206 IS DATA RECEPTION THRU MULTIPLE CHANNELS POSSIBLE?

208 TRANSMIT DATA THRU MULTIPLE CHANNELS

210 IS DATA FOR REAL TIME TRANSMISSION?

212 TRANSMIT ALL DATA THRU BASIC CHANNEL

214 TRANSMIT ESSENTIAL DATA ONLY THRU BASIC CHANNEL

END